CLAIMS

1. A fluid-tight junction comprising a first substrate assembly, a second substrate assembly, an elongate component passing through the junction, and a sealing gasket;

the first substrate assembly comprising

(1) a first substrate comprising a first end portion (FEP) comprising

(a) a first end portion (FEP) mating face which lies in an FEP mating plane, and

(b) an FEP conduit which (i) extends to the FEP mating face, and (ii) has a terminal portion adjacent to the FEP mating face, the terminal portion having an FEP conduit axis which is straight and perpendicular to the FEP mating face,

(2) a first substrate (FS) top face,

(3) an FS bottom face,

(4) two FS side faces,

(5) a primary FS alignment feature which (i) has a primary FS alignment axis which is parallel to the FEP conduit axis, and (ii) extends along a primary FS alignment face selected from the FS top, bottom and side faces, and

(6) a secondary FS alignment feature which (i) has a secondary FS alignment axis which is parallel to the FEP conduit axis, and (ii) extends along a secondary FEP alignment face which is (i) selected from the FS top, bottom and side faces, and (ii) is different from the primary FS alignment face;

the second substrate assembly comprising

(1) a second substrate comprising

(a) a second end portion (SEP) mating face which lies in an SEP mating plane,

(b) an SEP conduit which (i) extends to the SEP mating face, and (ii) has a terminal portion adjacent to the SEP mating face, the terminal portion having an SEP conduit axis which is straight and perpendicular to the SEP mating face,

(2) a second substrate (SS) top face,

(3) an SS bottom face,

(4) two SS side faces,

(5) a primary SS alignment feature which (i) has a primary SS alignment axis which is parallel to the SEP conduit axis and which substantially coincides with a primary FEP alignment axis, and (ii) extends along a primary SS alignment face selected from the SS top, bottom and side faces, and

(6) a secondary SS alignment feature which (i) has a secondary FS alignment axis which is parallel to the SEP conduit axis and which substantially coincides with the secondary FEP alignment axis, and (ii) extends along a secondary SS alignment face which is (i) selected from the SS top, bottom and side faces, and (ii) is different from the primary SS alignment face;

the elongate component

(a) having a component axis which substantially coincides with the FEP and SEP conduit axes, and

(b) comprising (i) a fixed portion which is secured within the FEP conduit, and (ii) a free portion which includes an intermediate portion which lies between the FEP and SEP mating faces, and a trapped portion which lies within the second conduit;

and the sealing gasket

(a) surrounding the intermediate portion of the elongate component, and

(b) having a deformed configuration which results from compression between the FEP and SEP mating faces, and which forms a liquid-tight seal between the elongate component and the FEP and SEP mating surfaces.

2. A junction according to claim 1 which includes a releasable mechanical retainer which retains the substrates in relative positions which maintains the sealing gasket in the deformed sealing configuration.

3. A junction according to claim 1 or 2 wherein the elongate component is a capillary tube, an optical fiber, or an electrical lead.

4. A junction according to any one of the preceding claims wherein the primary FS alignment feature is one of the FS side faces; the secondary first alignment feature is the FS bottom face; the primary SS alignment feature is one of the SS side faces and lies in the same plane as the primary FS alignment feature; and the secondary SS alignment feature is the SS bottom face and lies in the same plane as the secondary FS alignment feature.

5. A junction according to any one of claims 1 to 3 wherein the primary and secondary first alignment features are grooves in opposite side faces of the first end portion; the primary and secondary second alignment features are grooves in opposite side faces of the second end portion; the center lines of the primary first and primary second alignment features substantially coincide; and the center lines of the secondary first and secondary second alignment features substantially coincide.

6. A junction according to any one of the preceding claims wherein each of the first and second substrates is a microfabricated chip prepared by a process which comprises dividing a microfabricated composite into a plurality of microfabricated chips; and the first and second substrates were obtained by dividing the same microfabricated composite or by dividing microfabricated composites prepared by substantially identical procedures.

7. A junction according to any one of the preceding claims which further comprises a gasket retainer which substantially surrounds the sealing gasket and limits deformation of the sealing gasket.

8. A method of making a junction as claimed in any one of the preceding claims, the method comprising

(I) providing a first substrate assembly which comprises

(A) a first substrate comprising

(1) a first end portion comprising

(a) a first end portion (FEP) mating face which lies in an FEP mating plane, and

(b) an FEP conduit which (i) extends to the FEP mating face, and (ii) has a terminal portion adjacent to the FEP mating face, the terminal portion having an FEP conduit axis which is straight and perpendicular to the FEP mating face,

(2) a first substrate (FS) top face,

(3) an FS bottom face,

(4) two FS side faces,

(5) a primary FS alignment feature which (i) has a primary FS alignment axis which is parallel to the FEP conduit axis, and (ii) extends along a primary FEP alignment face selected from the FS top, bottom and side faces, and

(6) a secondary FS alignment feature which (i) has a secondary FS alignment axis which is parallel to the FEP conduit axis, and (ii) extends along a secondary FEP alignment face which is (i) selected from the FS top, bottom and side faces, and (ii) is different from the primary FEP alignment face;

(B) an elongate component comprising

(a) a fixed portion which is secured within the FEP conduit, and

(b) a free portion which extends away from the FEP mating face, the free portion including an intermediate portion which is adjacent to the FEP making face; and

(C) a sealing gasket around the intermediate portion of the elongate component;

(II) providing a second substrate assembly which comprises

(A) a second substrate comprising

(1) a second end portion comprising

(a) a second end portion (SEP) mating face which lies in an SEP mating plane, and

(b) an SEP conduit which (i) extends to the SEP mating face, and (ii) has a terminal portion adjacent to the SEP mating face, the terminal portion having an SEP conduit axis which is straight and perpendicular to the SEP mating face,

(2) a second substrate (SS) top face,

(3) an SS bottom face,

(4) two SS side faces,

(5) a primary SS alignment feature which (i) has a primary SS alignment axis which is parallel to the SEP conduit axis, and (ii) extends along a primary SS alignment face selected from the FS top, bottom and side faces, and

(6) a secondary SS alignment feature which (i) has a secondary SS alignment axis which is parallel to the SEP conduit axis, and (ii) extends along a secondary and SEP alignment face which is (i) selected from the FS top, bottom and side faces, and (ii) is different from the primary SEP alignment face;

(III) providing an alignment jig which includes primary and secondary jig location features having parallel jig location axes;

(IV) placing the first and second substrate assemblies in contact with the alignment jig so that the primary and secondary FS and SS alignment features are in contact with the primary and secondary jig location features and the SEP mating face is opposite to and parallel with the FEP mating face; and

(V) sliding the first and second substrate assemblies towards each other, while maintaining the alignment features in contact with the jig location features, so that the free portion of the elongate element enters the SEP conduit and the sealing gasket is compressed between the FEP and SEP mating faces; and

(VI) maintaining the mated configuration of the first and second substrate end portions produced in step (E).

9. A method according to claim 8 wherein

(a) the primary and secondary FS and SS alignment features are grooves as defined in claim 5,

(b) the jig location features are flanges which

(i) fit within the grooves,

(ii) lie in the same plane, and

(iii) are separated from each other by a constant distance which permits the first and second end portions to slide towards each other in step (F).

10. A method according to claim 9 wherein the flanges are part of a planar generally U-shaped article which is sandwiched between a base and a top.

11. An assembly which is suitable for use in a method as claimed in any one of claims 8 to 10 and which comprises

(a) two planar parallel side faces, each of which includes a groove, the grooves being separated from each other by a constant distance and lying in the same plane,

(b) a mating face,

(c) a top face which is at right angles to the mating face,

(d) a bottom face which is parallel to the top face, and

(e) a microfluidic conduit which (i) lies between the top and bottom faces, (ii) extends to the mating face, and (iii) adjacent to the mating face, has an axis perpendicular to the mating face.

12. A method of making a microfluidic substrate suitable for use in the method of any one of claims 8 to 10, the method comprising

(A) providing a microfabricated composite having (i) a plurality of microfluidic conduits, and (ii) a plurality of additional conduits which lie in the same conduit plane and are parallel to each other; and

(B) dividing the composite along (a) a plurality of groove-forming planes which are parallel to each other and each of which is (i) at right angles to the conduit plane and (ii) passes through an additional conduit but not through a microfluidic conduit, and (b) a plurality of mating planes which are parallel to each other and each of which is right angles to the conduit plane and to the groove-forming planes, thus producing a plurality of said microfluidic substrates.

13. An assembly which is suitable for use in the method of any one of claims 8 to 10 and which comprises

(1) a first substrate assembly as defined in any one of claims 8 to 10, and

(2) a gasket retainer which substantially surrounds the sealing gasket and limits deformation of the gasket.

14. An assembly which comprises

(1) a first substrate assembly as defined in claim 8; and

(2) a deformable sealing gasket which surrounds the intermediate portion of the elongate component.

15. A junction comprising an elongate component which passes through the interface between two substrates, at least one of the substrates being a microfluidic substrate, and the elongate component being surrounded, at the interface, by a gasket.

16. A method of making a junction, preferably a fluid-tight junction, which comprises providing two substrates, preferably microfluidic substrates, each of which has a pair of alignment features thereon, one of which has an elongate component extending from it and the other of which has a conduit within it; placing the substrates on an alignment jig with the alignment features in contact with the alignment jig; and sliding one or both of the substrates along the alignment jig so that the elongate component enters the conduit.

17. An assembly which comprises a microfluidic substrate and which has two parallel side faces each of which includes a groove, the grooves being separated from each other by a constant distance and preferably lying in the same plane.

18. A method of making an assembly as claimed in claim 17, the method comprising

(A) providing a microfabricated composite having a plurality of groove-forming conduits which are parallel to each other and which preferably lie in the same conduit plane; and

(B) dividing the composite along (a) a plurality of groove-forming planes which are parallel to each other and each of which (i) is at right angles to the conduit plane and (ii) passes through one of the conduits, thus producing a plurality of said microfluidic chips, and (b) a plurality of mating planes which are parallel to each other and each of which is at right angles to the conduit plane and to the groove-forming planes, thus producing a plurality of said assemblies.